

**CLAIMS**

What is claimed is:

- 1    1.    A tunable diffraction grating comprising:
  - 2                    a cell with a first cell wall spaced from a second cell wall;
  - 3                    electrodes disposed on facing surfaces of the first and second cell walls; and
  - 4                    an array of nematic liquid crystal convective rolls, wherein said convective rolls
  - 5                    are arranged periodically in space between said first cell wall and said second cell wall;
  - 6                    and
  - 7                    a polymeric network stabilizing said array of nematic liquid crystal convective
  - 8                    rolls.
  
- 1    2.    The tunable diffraction grating of claim 1, wherein the convective rolls are arranged with
  - 2                    a grating constant approximately twice the separation distance between said first and
  - 3                    second cell walls.
  
- 1    3.    The tunable diffraction grating of claim 1, further comprising:
  - 2                    a power source connected to said electrodes to apply an electric field, wherein said
  - 3                    convective rolls are arranged with a structure factor, and said structure factor is adjusted
  - 4                    by application of an electric field through said power source.
  
- 1    4.    A method for producing a diffraction grating comprising the steps of:
  - 2                    introducing a polymerizable mixture including nematic liquid crystal, dopant, and
  - 3                    polymerizable precursor between two electrically conductive substrates;
  - 4                    applying a potential difference across the polymerizable mixture to cause the
  - 5                    nematic liquid crystal to assemble into an array of convective rolls; and
  - 6                    stabilizing the convective roll structure by forming a polymer network from the
  - 7                    polymerizable precursor, wherein the polymer network is templated by the convective
  - 8                    roll structure.

1 5. The method according to claim 4, wherein the polymerizable mixture further includes  
2 an initiator, said initiator being activated in said step of stabilizing to initiate the  
3 formation of the polymer network from the polymerizable precursor.

1 6. The method according to claim 5, wherein the initiator is a photoinitiator and said step  
2 of stabilizing includes photoinitiation of the photoinitiator.

1 7. The method according to claim 4, wherein said convective rolls are arranged with a  
2 structure factor after said step of stabilizing, and the method further comprises, after said  
3 step of stabilizing:  
4 adjusting the structure factor by application of an electric field through at least one  
5 of the electrically conductive substrates.